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ABSTRACT

This issue of the newsletter of the American Association for the Advancement of Science (AAAS) presents articles relating to the back to basics movement, science in the elementary school, elementary science programs, and marine science for handicapped students. In all articles, the back to basics issue as it relates to science instruction is emphasized. (SL)

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SCIENCE EDUCATION NEWS

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Orin McCarley
Managing Editor

April 1977

An editorial in the March 1977 issue of *Phi Delta Kappan* describes the back-to-basics movement as today's media event. It is not difficult to find arguments which advocate a return to teaching the basics in our schools. The origins of these arguments resemble the reactions to a more dramatic media event back in 1957.

Sputnik. As in 1957, there are today dissatisfactions with what our children are learning—or not learning. And these dissatisfactions frequently translate to convictions that changes in our schools are imperative.

Sputnik gave impulse to the emerging efforts to improve schooling in science that had begun in the mid-1950s. The initial emphasis on improving secondary school science was broadened. Scientists, educators, and teachers joined together to develop experimental and innovative science curriculum materials at all levels during the '60s and '70s.

Today we hear two opposite evaluations of these curriculum reform efforts of the past twenty years. Some say that in spite of the new curricula there has been little change in what goes on inside the classroom. The textbook still dominates instruction. The new curricula have not really been implemented. Thus, our recent efforts at curriculum reform are incomplete. Others point to new curricula as either ignoring the basics or diverting children's learning away from the basics; they emphasize frills. New curricula are often blamed for falling test scores and even for some of the ills of society.

More rarely does the public hear any analysis of what is basic to elementary schooling, or any distinctions between schooling and education. More rarely does the public hear a reasoned plea for science or for the arts in elementary school. The public often does hear that educational frills cost too much, and that science or the arts cost too much, while their children argue the "merits" of paying a third baseman a \$400,000-a-year salary.

Two fundamental situations stand out today. First, as a society we Americans find ourselves totally immersed in efforts of democratic government entwined in problems of a worldwide nature. A glimpse of the nature and scope of these problems can be gleaned from a sampling of titles of editorials in *Science* during the

past year: "Oil and the World's Future," "Learning about Energy the Hard Way," "Environmental Cancer," "Our Last Vaccine?," "Viking I," "Electronics Revolution," "On Working with the Soviets," "Basic Research and the Congress," "Federal R & D and the Economy," "Scientific Quests and Government Principles," "The Recombinant DNA Debate," "Communicating with the Public."

Second, as individuals coping on a day-to-day level we find our over-mediated lives literally bombarded with messages. Age is no escape. The messages reach the old, the young (in and out of school), and the young becoming old. Frivolous and serious messages are jumbled together. And frequently the messages are *answers!* How do we sort them? How do we decide?

In these fundamental problems we have no shortage of potential media events. What should we do *now* to prepare our children to be able to cope with their own futures? What skills, attitudes, understandings, and values *will* be necessary for individuals to sustain a democracy that must confront science-laden problems amidst oceans of information?

Is it enough to prepare our children to be spectators? Is it enough to "return to" the 3 R's?

In this issue of *Science Education News* four persons associated professionally, and in various ways, with education address the issue of back-to-basics. They offer their thoughts on the importance of science in the elementary school. JOSEPH M. DASHBACH

We in education have lost track of the public. The "back to basics" movement makes this evident. As a school board member, I have had reason to refresh myself about what the general public seems to want from elementary education. It appears to be this: enough literacy to read a set of directions, enough writing to write legibly and (more or less) correctly, and enough arithmetic to make change accurately, add up a bill, and (for some) to prepare an income tax form. And that's all. To be sure, there are some people who want more, but they are in the articulate minority. So it isn't surprising that the rebellion against school costs

reflects the really broad agreement about what is basic.

The professionals are far more ambitious, of course, and have been since the beginning. In addition to the rudimentary skills needed for survival, those who take elementary education seriously have intended to deal with intellectual understanding, with the development of character, with citizenship, and with the development of a valid personal life—a constructive view of one's self, or (to put it differently) the development of legitimate grounds for self respect. Not that the schools seek to do these things alone, of course. The many other educational influences also do their part—or do their mischief. However, we are far from having a general public consensus on these purposes. Only when they seem to be violated, or contradicted, by the schools do we hear from the public. Even then, the general public takes no part in the debates that emerge. All the general public really asks of the elementary schools is that they impart a few rudimentary skills.

We are called upon to enlarge the public vision of what might be. We have such a vision, but we haven't spoken plainly to the general public concerning what the vision is. It is the purpose of this paper to attempt such plain talk about science as a basic school subject, at the same time calling attention to a problem that exists among elementary teachers who offer science instruction.

Any school activity, we say to ourselves, is nested in a series of intentions that ultimately derive from a view of the human condition, and of a good life in a just society. It is these larger purposes, we say, that are actually basic, even basic for survival.

Where does elementary school science fit into these purposes? In what sense should we consider it basic, especially given the narrowness of the public view?

There are three requirements a subject must meet, if it is to be basic: (1) it must offer a useful and significant way of encountering the world; (2) it must be generalizable; (3) it must be teachable to most children within the constraints of real schools and real settings. Moreover, to be sound, programs must pursue broad aims consistently—they must avoid scatter and fragmentation; they must be capable of assessment, and they must allow for many modes of learning.

Let us examine elementary science from this point of view. Do the usual programs meet these criteria? We shall see that they do in part, and don't in part.

The prevalent programs have not changed much since the '20s and '30s, despite the development of the NSF programs during the '60s. Consider the tradition of elementary science teaching. We must consider it, because the actual curriculum in most elementary schools is a continuation of its own tradition, in large measure.

Elementary school science as we know it begins with the object lesson, continues with nature study (or nature worship), and ends with the progressive programs of the '20s and '30s, now recapitulated somewhat in the recent environmental education programs. The NSF programs do not grow out of this tradition. Some of them explicitly contradict it.

The traditional programs were never universally

offered, though they were (and are) widespread. Considered as "basic," they have some strengths and some shortcomings. By and large, they deal with matters already interesting to children, and are therefore teachable: small animals, plants, the weather, insects, and so on. The programs suffer, however, from scatter; they do not have consistent purposes, nor do they offer a way of confronting the world. They seek, usually "appreciation of nature" as a general goal, but "appreciation," being undefined, is not assessed, and the children end up with a scattering of information and (if all has gone well) an awakened curiosity about some natural phenomena. Although attempts are made to teach a version of scientific (i.e., logical) thinking, these attempts are not ordinarily pursued systematically.

The traditional program therefore does not meet our requirements for a basic subject. It does not offer a significant way of viewing the world—one could get along without the scattered information about nature—and it does not seek the building of large-scale generalizations. All of this must be admitted, though the program, in the hands of skilled teachers, is enormously intriguing. In general, however, it is descriptive, not explanatory. It is, as Robert Karplus has said, natural history, not science.

What, then, is science? Let me offer a layman's view. I must dare to characterize the scientist's way of viewing the world, though some readers of this publication will have other and better versions of it. Scientists look behind apparent data for fundamental explanations. They do this through detailed descriptions of what is, but they proceed by "peeling the onion" and through experiment, always looking for the reality underneath. As this process proceeds, the surface appearances of things come to be explained by what underlies them, until ultimately the scientist achieves large-scale explanations of the nature of things and their interaction. The process is never-ending, as is evident, for example, in the case of physics.

This special way of viewing the world is basic to living in it. Those who lack it (i.e., most of us) are perpetually at the mercy of those who have it. Even more seriously, in today's world, those who lack it cannot understand those who have it, in a time when the general public is required to participate in scientific decisions, on the basis of a way of thinking they know nothing about. For example, consider the poor quality of the public discussion of recombinant DNA, or of the proliferation of nuclear generating facilities.

Science is basic to a feeling of power and participation in the world, and in today's world, to effective citizenship. But it has other basic contributions to offer: the ethical standards scientists are required to uphold can, if understood, contribute to character, or moral development. The astonishment scientists feel at the nature of the universe contributes to their spiritual lives in the form of Phenix's "transcendence." Similar argu-

¹ Phenix, Philip H.: "Transcendence and the Curriculum," Chap. 7 in Eisner, Elliot and Elizabeth Vallance (eds.), *Conflicting Conceptions of Curriculum*. Berkeley, Calif.: McCutchan, 1974.

ments can be made for the contributions of science to the other aspects of the human condition. Science, properly considered, meets the requirements for basic education indicated above.

However, the contributions will not be made if the science programs remain as they usually are. A "nature table" full of unassorted objects may well pique the curiosity of the children, but if we leave it there—and we very often do—we will have settled for a child's untutored thinking. Schools exist to help children grow up. While we have to "begin where they are," we certainly don't intend to leave them there.

Is science a basic school subject? It most certainly is, provided it is science, and not something else. In too many schools, it is mere information, and in some, little more than entertainment. Science teachers will do well to plead the case for science on the most serious grounds, if the public is to be enlightened on what is really basic.—ARTHUR W. FOSHAY, *Professor Emeritus, Teachers College, Columbia University, Rowe, Massachusetts 01367.*

The Basics and the Study of Science

Does the current enthusiasm for basics threaten the study of science in the elementary grades? On the face of it, such a fear seems groundless, but the apprehension may not be baseless if:

- (1) basics are equated with proficiency in the 3 R's;
- (2) if the demand for functional literacy is to be satisfied by competence in reading advertisements, filling out application forms, making change, following written directions;
- (3) if schooling is tested and judged solely by the ability of the learner to replicate particular items of instruction;
- (4) if the value of science study is judged by the ability to "apply" it in solving practical problems of daily life, e.g., repairing the car, fixing leaky faucets, buying stocks, and the like.

Some evidence that the first two conditions already obtain is found in the arguments advanced for mandating the priority of basics and minimal competency requirements in California, Maryland, Florida, and several other states. One California legislator, Leroy Greene, is quoted as saying, "When a youngster gets out of high school, I expect him to be able to read a newspaper article, tell me what it said, and write me a couple hundred words on it in proper English" (*Time*, Feb. 28, 1977, p. 74). It would be helpful to know which articles and newspapers Mr. Greene would use as tests and what criteria in addition to proper English he would apply to the reports. Students have been known to write in proper English several hundred words of irrelevant and misinterpretation of what they have read.

More pertinent to the third condition is the answer given by a legislator when asked what the schools could do to improve their standing with the public and the taxpayer. He said that if every elementary teacher in

the state devoted ten minutes a day to drilling the number facts, in one year the response of the public would be dramatically favorable.

Undoubtedly the proponents of basics regard them as a minimal desideratum but in the minds of many legislators, and perhaps of some school people as well, minimal competence will be accepted as sufficient. The latter view comports well with accommodation to reduced budgets and a belief that some segments of the population because of a lack of intelligence, motivation, or both cannot profit from anything more.

At this point an ambiguity in the term "basic" needs to be noted. For a long time the Council for Basic Education has attacked frilly, educationist inspired deviations from the standard study of the standard disciplines as a betrayal of basic education. However, study of the basic disciplines is often confused with basics as competence in the 3 R's. The ambiguity is disconcerting, to say the least, because the constituencies battling for basic education and the basics by and large do not occupy the same strata of the economic and educational establishments. The former usually inhabit the academy and the suburbs and belong to the upper-middle class; the latter for the most part dwell in the inner city and feel that the public schools, by not guaranteeing the basics, are denying their children access even to the lower rungs of the middle class. Science study qualifies easily for basic education, but not so readily, if at all, for the basics.

The threat to science study posed by the third and fourth conditions listed above is of a different and perhaps a more important order. If one accepts the theory that for X to have been learned, the learner must be able to replicate X on demand (condition 3), then not only elementary science but even collegiate study of science flunks the test. Much of the input simply cannot be recalled—if not reinforced by repetition—after even short intervals, but it does not follow that the school inputs no longer function. Evidence as to whether they do or do not function requires careful and subtle comparison with populations that had no access to such instructional inputs. Our assessment instruments, so far as I know, make no such comparisons.

The application criterion is even harder to satisfy. One copes with the predicaments of daily life by using standard techniques for standard cases. In changing a tire one does not rehearse or invoke the principles of physics; adeptness in the use of the tire changing kit is sufficient. Strictly speaking, applying science involves translating a principle, e.g., Boyle's law or Ohm's law, into a device that in turn can be used for human needs (technology). Junior science fairs give ample evidence that young people can apply science, but most of the adult population uses the applications devised by others.

The rationale for the study of science at any level, therefore, depends on outcomes that function in ways that are neither entirely or predominantly replicative nor applicative. If retrieval of information is the goal of schooling, then manuals, tables, and the like are better resources than science courses. If application is

the test, then practicing a technique has better payoff than the study of science.

What meaning, then, can one attach to the claim that the study of science is basic? I suggest that by basic we can, and perhaps should, mean two other uses of schooling, namely, associative and interpretive. By the associative use I mean the reinstatement of items by cues that are not necessarily related to them logically. For example, association by resemblance, metaphor, analogy is not the same as inferring consequences from premises. A rich and varied store of concepts and images enlarges the comprehension capability of the subject because it supplies a matrix of meanings. Poor readers may suffer from an impoverished conceptual store as well as from a lack of decoding skill. Science stocks this store with facts, relations, and concepts that enrich experience in ways that are not available to children of nonscientific cultures. But the store can be used without the user being able to recall the storing of the items, and the input need not be restated exactly as put in. Rarely do the inputs remain as learned, but we are far from clear about the transformation they undergo.

Interpretation can be equated roughly with translation of a situation or problem into a new context, e.g., a cold wave or increase of food prices into the context of meteorology. Most of what is commonly called application, on this view, is more accurately called interpretation. Science provides specialized conceptual schemata or frames or stencils for interpretation. We think *with* them in life; we think *on* them or *about* them in school. The sign painter concentrates on the sign; the traveler on its meaning.

The justification for the study of science in the elementary grades, therefore, lies in the need for early stocking of the imagic-conceptual store with facts, concepts, and relationships, first to build resources for interpretation, and second for structuring the interpretation in the manner of science. In other words, the basic foundation for scientific thinking requires both content and process, and beyond this I leave the proper packaging of materials for instruction at various age levels to science educators. However, it is up to all educators to convince the public—and perhaps each other—that learning to interpret experience in the manner of science (or, for that matter, in the manner of history, economics, or geography) is worthwhile and that success in schooling is not tested by its replication or application to the exigencies of practice.—H. S. BROUDY, *University of Illinois, Champaign-Urbana*.

NOTE: The arguments used here to justify the study of science also hold for the study of any subject in general education and for the theoretical portions of curricula of education for the various professions. For a more detailed version of the argument on the uses of knowledge or schooling see my "On Knowing With," *Proceedings of the 26th Annual Meeting of the Philosophy of Education Society*, pp. 89-94; "Can Research Escape the Dogma of Behavioral Objectives?" *School Review*, 79:1, Nov. 1970, 43-55; "The Life Uses of Schooling as a Field for Research," Chapter IX in the 71st N.S.S.E. Yearbook, 1972, and "Research into Imagic Association and Cognitive Interpretation," *Research in the Teaching of English*, 7:2, 240-259, Fall, 1973; "Can

Research Provide a Rationale for the Study of Science?" *Journal of Research in Science Teaching*, 10:3, 1973, 227-33. —H.S.B.

Basic Education and Science in the Elementary School

Does your school system, in describing the objectives of its educational program, use such terms as:

- Help children develop their curiosity and ask *what*, *how* and *why* questions.
- Help children learn how to think critically.
- Help children develop problem-solving skills.

These are among the most important reasons given by educational administrators for teaching elementary school science in Paul Blackwood's 1961 survey of elementary science for the Office of Education.¹ The first two objectives given ranked first and second. In 1971, administrators and teachers in Pennsylvania were given a similar list of objectives, and these three were ranked first, second, and third in importance.² Science teaching is expected to perform in a very special way.

There is no conflict between science and basic education. Acquiring the basic skills is one of the principal reasons for a child attending school. There should be great emphasis on helping children gain the fundamental language, reading, writing, and arithmetic skills. These, however, are not the entire content of elementary education, nor are they the sole concern of basic education. We note this advice from the Council for Basic Education (CBE), an organization whose dedication to the basic skills is without equal:

What is being done about the rest of basic education while the strife goes on to make education safe for the 3 R's? We keep reminding ourselves and others that there is much more to basic education than reading, writing, and arithmetic, but the clamor for skills makes it increasingly difficult to hear much else.

Remember that it is CBE's purpose "to initiate and support measures to ensure that all students, except the severely retarded, receive adequate instruction in the basic intellectual disciplines, especially English, mathematics, science, history, foreign languages and the arts."³

Learning the higher skills of thinking is one of the broad and never relinquished aims of education. If there are some unfortunates for whom relatively little will be accomplished in elementary school beyond trying to give them "survival skills," it is the duty of the schools (1) to minimize that number, and (2) to fulfill their obligation to the vast majority of children by providing a complete education.

School curriculum guides invariably contain educa-

¹ *Science Teaching in the Elementary Schools (A Survey of Practices)* by P. E. Blackwood, OE-29059, Circular Number 749. Washington, D.C.: U.S. Department of Health, Education and Welfare, 1965.

² *Science Teaching in Pennsylvania Public Elementary Schools: A Report* by J. T. Belluci, I. T. Edgar, C. A. Guerriero, and B. N. Belluci. Wilkes-Barre, PA.: Educational Development Center, Wilkes College, 1973.

³ *CBE Bulletin*. Washington, D.C.: Council for Basic Education, 725 Fifteenth Street, N.W., Jan. 1977, p. 14.

tional objectives such as those quoted above in one form or another. A legitimate question is whether they are included as part of the professional jargon, to impress a gullible public, or whether these objectives describe a genuine intention to help children attain systematic reasoning powers. The accountability movement should be testing this question as well as the more publicized concern as to whether children end their schooling with minimal "survival skills."

Because the natural sciences are rooted in the real world in which children are growing up, many of the phenomena and materials with which science deals are intrinsically fascinating to children. Living plants and animals, physical objects close at hand or familiar through vivid description, the weather, the moon and stars, and all the rest excite the child's curiosity. Often it is satisfying to an inquisitive youngster to receive an explanation or be told some interesting facts. One cannot hope to have personal experience with all the phenomena about which we are curious. Yet experience is the key to understanding, providing a framework upon which verbal explanations can be accepted and integrated.

In essence, the difference between *doing* and *being told about* describes the change brought to elementary school science by the widely adopted "inquiry" materials and curricula of the last few years. For the very young, experience means actual handling of materials, physical contact with forces and objects, and seeing or hearing changes that they themselves help to bring about. The kinesthetic learning gained by throwing and catching a ball has no parallel in merely watching or being told about it.

By what processes do children gain mastery and understanding of their environment? As a simple example, an object may be selected from a tray of diverse materials. The child is asked to describe it. In this way concepts of physical properties are perceived and sharpened: color, hard or soft, heavy or light, big or little or in between, can see through or not see through, round or sharp or square, smooth or rough or slippery, and so on. Compare the object with another. Choose a property of objects and select all those that have that property. Arrange things according to some inherent ordering of a property (size, weight, light or dark, likely to use in the home, or whatever). *Describing* and *comparing* are fundamental processes of science. Children like to do them, and can be quite successful. Let us note all the learning bundled up in the very act of describing and comparing: among other facets, words spoken and remembered, words and concepts structured in a hierarchical sense (light and heavy become weight, light and dark are refined into shadings and defined as end points), and perhaps most important of all, a system for dealing with unfamiliar objects and objects in general.

The child is encouraged to *observe*. He or she must see, touch, taste, hear, weigh, try out. Skills newly acquired are called upon to describe what the child has personally observed. The child learns to *classify*. *Measurement* is introduced, opening a new world of pre-

cision—how much, how many, how long, how heavy, how much farther, how much larger, how much warmer.

Inferring is brought into play: "I observed that this happened to the guppies in the tank; was it because . . . ? The intellectual process of *predicting* evolves, such as "If I do it this way instead of the way it was done last time, then the result ought to be . . ." *Experimentation* comes easily to children, given discreet guidance and the carefully designed materials found in the better science activity programs.

When the child is actively involved with the materials in a science unit, these and other processes of science are the basis of the habits of critical thinking that schools ever are so important among their educational objectives. There is a duality here that should not be missed. First, a science class without experiences in thinking is shorn of one of its greatest appeals to children. Second, because the science program can so conveniently be organized around a natural progression of thinking processes, it is a part of the total curriculum that is most conducive to developing abilities in reasoning.

Thus, in addition to its content and structure, science in the elementary curriculum holds an almost unique position in its potential to satisfy that basic responsibility of education—the development of logically reasoning human beings. This is unlikely to occur, at least as an outcome of science, if that subject is treated as a spectator sport, with no direct student involvement in science activities. The child must learn to observe, to ask questions about what has been observed, to plan procedures whereby his/her questions can be answered, to gather data efficiently and interpret it, and to make judgments based on evidence rather than opinion or guesswork. From start to finish in such an exercise, the child is the prime participant, moving from one stage to the next only on the basis of what has occurred with the materials in the science unit. In these exercises the student does not know the answer in advance; he/she directs an inquiry and discovers the results of following that line of inquiry.

The foregoing does not in any way discount the teacher's role. A major difference from traditional practices is that the teacher here does not continually tell the child what he has to know, but plans so that the child learns through his/her own participation. Moreover, there will be times when the science program will extend beyond the activity-centered curriculum. These are most assuredly not programs without reading. Written directions are included in the units, and results generally require written reports. Extended readings about the topics should be available in the classroom, as opposed to the school library, to encourage their use. Moreover, the typical activity program cannot cover all topics of interest to children, nor all topics covered in a comprehensive syllabus. Readings for those purposes are a necessary adjunct to an inquiry program. There is no injunction that the child must discover everything for him/herself, nor should the value of adding to one's body of information and understanding through reading be ignored.

Why, then, if reading is a desirable method for learning some science, shouldn't the subject be covered from a well planned textbook? The trouble lies with the traditional tone and usage of texts in elementary classrooms. Traditional text series have long been the mainstay of elementary science, and probably still constitute the science curriculum in the majority of classrooms even today, although they do not dominate as they once did. A traditional text usually advocates use of demonstrations and special student kits as part of a unit, but the book is so organized that it permits the teacher to omit the student activity entirely and still maintain the continuity of the text. Moreover, the character of suggested student work almost always tends to be verification of what the book tells the child, with results prominently printed in the text so that the child is a passive follower rather than a person stimulated by thinking a problem through.

Most observers find that elementary school teachers rely almost exclusively on the textbook if the school provides a text-oriented program. This "tell the child" teaching leads to passive learning of superficialities. Terms are defined and memorized, facts are laid out to be regurgitated on demand. Abstractions—e.g., work, force, energy—are bandied about without assurance that students have physical experience on which to base an understanding of these concepts.

There is no guarantee that a science program will lead to critical thinking among children. Educators have to expend effort if they hope to achieve that objective. They will have to demand active rather than solely passive experience for the child, and then provide the means by which an activity-based program will work: purchasing properly designed materials, facilitating and encouraging their use in an appropriate sequence, investing in a high quality training of teachers on the objectives of science teaching and the use of inquiry materials, and lending sympathetic support for a fully developed elementary science program. Rounding out the program for scope and depth, a wide range of readings should be supplied from among the excellent resources available, plus as much as can be afforded of the outstanding films and other audio-visual materials known to most modern science supervisors.

Science is one of the essential, general education subjects. A citizen today is selectively illiterate without an understanding of many issues with origins in science and technology. These issues are now commonly mentioned in the daily news. Here are just a few: energy demands, nuclear power, transportation tangles, environmental deterioration, waste disposal, increasing reliance on electronic gadgetry, social impact of computers, and society's definition of death.

Confronted by these sometimes terrifying issues, we demand decisions that are optimal. But who will decide if not the citizens themselves? How are they receiving—or are they receiving—relevant factual information, or familiarity with the principles behind the technology involved? What should the schools be doing to create a base for such understanding?

Will tomorrow's citizen choose to resolve these tech-

nologically rooted conflicts through the logically reasoned approach rather than demagogic and irrational emotional appeals? Will that citizen understand how a logical approach is reached? Will he or she possess an intuitive preference for, and an awareness of what constitutes an adequate scientific test to support a position in a controversy? Will he or she seek the processes by means of which that position has been reached: proper choice of assumptions, control of important variables, evidence to back all conclusions, identification of factors excluded from the study, need for independent verification, exploration of side effects, and the probability that revisions will be needed and more evidence demanded as improved hypotheses better describe the known data?

Society is asking a great deal of the citizen, on the assumption that the citizen wants to be in control of his/her life to the extent possible. Abilities listed here are developed only after years of disciplined study. The foundations are laid in the elementary school. To cope with the modern world, and to equip oneself with the power of critical thinking, science is more than ever a part of one's basic education.—HOWARD J. HAUSMAN, *Educational Consultant, 1009 S. Belgrade Rd., Silver Spring, Maryland 20902.*

Reference

Choosing a Science Program for the Elementary School, by H. J. Hausman, Occasional Paper No. 24. Washington, D.C.: Council for Basic Education, 1976. \$1.00 single copy.

Elementary Science Programs: Changes in the Seventies

The 3 R's, mixed with a measure of socialization, generally comprise the major bill of fare in a traditional elementary school curriculum. The "frills" of social studies, science, music, art, and drama are present but are seldom considered as central to the curriculum. Traditionally, they provide a vehicle by which the 3 R's have meaningful or applied bases. For example, "wheels" can be used as a topic about which a child can read, or write, or compute. Similarly a more current theme, such as "energy," can be used. Maybe this approach would satisfy the proponents of the "back to basics" movement. But, is it teaching science?

It was this question, undoubtedly with an added impetus from Sputnik, that led to a dramatic change in elementary science curricula in the '60s. That period provided one of the few instances when education professionals determined the direction of education. Generally educators act in a reactive rather than a leadership mode, responding to the needs expressed by society. Perhaps this trend is rooted in the tradition that a teacher's role is to prepare his or her charges for life in society, a role that is certainly not entirely inappropriate.

In the '60s, educators attended to the call to upgrade education in directions that the educators considered to be important. Science was not to be included in the curriculum merely as a vehicle for the 3 R's. Rather

science was to be included in the curriculum on its own merit.

The professionals, secondly, considered that it was not sufficient to teach children a set of scientific facts but rather that children should learn generalizable process skills. Curricula thus contained topics such as "classification," rather than "animals on the farm."

A third consideration was the levels of development of students in the elementary schools. Piaget and Bruner suggested that a child was not at the stage of abstract reasoning in the elementary grades so there was little purpose in teaching the child rote definitions. Rather it was imperative to have active, "hands-on" learning experiences. Gagné, too, was a strong influence. He stressed the sequential nature of learning. Certainly in mathematics one would not plan a curriculum exclusively on questions posed, or comments made, by students; rather, a sequence of content is adhered to based upon the structure of mathematics. For years in science, however, elementary school children learned about shells, fall leaves, and tree buds because they were brought to school by the students.

In the curriculum movements of the '60s the professionals emphasized sequential, purposeful elementary school science activities. How has this emphasis changed in the late '70s and how has it been influenced by the "back to basics" movement?

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There has been a move to listen more acutely to the expressions of society as a whole and particularly to the cry, "back to basics." Reactions suggesting that the curricula of the '60s did not teach "science" have not been ignored. In the '70s there are new curricula that are organized around topics more traditionally considered as science. However, there has not been a complete retreat to the earlier "fact-centered" curriculum; the processes of science are still an integral part of some. For example, in the BSCS-Lippincott Elementary School Science Program,¹ science does have integrity of its own and is not merely a vehicle to make palatable the learning of the 3 R's. The curriculum does, however, integrate process skills from other content areas such as the listening skills of the language arts. The active character of this elementary science curriculum is still evident as is the concern for matching the curriculum to the developmental sequence of the learner.

One significant difference between the science curricula of the '70s and those of the '60s is the inclusion of materials presented in written form for the students. A concern of the '60s was for a child to be able to experience success in, and enjoyment of, science regardless of his or her other capabilities—such as the ability to read. Thus, written materials were generally omitted so that reading competence would not be an obstacle to learning science. Since that time there have been two important thrusts related to reading in the elementary school. First, is the "Right to Read" program which has led to the development of expanded reading materials and an improvement in the ability of elementary school children to read. Second, readability indices are being used increasingly to analyze written materials designed for student use. These analyses have demonstrated that material with substantial content can be written at a level appropriate for young children. It has always been recognized that many young children enjoy using their newly acquired reading skills.

The written materials produced today are different from the elementary science textbooks of the pre-1960s which tended to use the content setting of science to teach reading. Now, the text is used to provide direction in learning science in a "hands-on" manner. Written materials have also made the teaching of active science at the elementary school level more compatible with the current trends for individualization and self-guided instruction. Without written materials for the student science teaching had to occur in group settings with adult direction. The inclusion of reading materials in the science curriculum can relate elementary science to the current demand for "back to basics."

Another aspect of the science curriculum that is related to the 3 R's is knowledge of and ability to use metric measurement. Early experiences in introducing the metric system in the science curricula of the '60s produced only limited success, partly because of lack of wide exposure and partly because of lack of flexibility. Marcuccio has stated, "There is a critical need to in-

¹ Biological Sciences Curriculum Study/Lippincott Elementary School Sciences Program. Philadelphia, Pennsylvania: J. B. Lippincott Co., 1976.

corporate metric usage throughout the curriculum and every teacher must think and speak the language. Total immersion throughout the school experience is important." In the early "New Math" programs much effort was expended on terminology, for example, the accurate use of the terms *number* and *numeral*. More recently this has been recognized to be of less concern than a solid knowledge of the concepts. Use of metric measurement in the science curriculum will reinforce its growing importance in the mathematics and language curricula.

A continuing concern among professionals specializing in elementary school science is that of the time allotted by the schools for science. An early criticism of the new curricula of the '60s was the amount of time required if all the desired material were taught. Probably these concerns would not have arisen had science been considered an important part of the elementary curriculum, for which sequential treatment is essential. However the same criticism continues to be voiced today. One solution, offered by Reid and McGlathery, is, "To compensate for the shorter time given to science we try to extend science into other communication areas." However, this solution can easily lead to the use of science as a tool for teaching the language arts as in earlier years. A change has to occur in the values of society. Society must support the inclusion of science in the elementary schools. Perhaps if the work of Raths' and his colleagues has influence, classroom time will be spent more efficiently in learning the so-called "basics." Not only will competence in the 3 R's increase, but time will be available to integrate the teaching of science, social studies, art, and music in an authentic manner.

Pessimism about the place of science in the overall curriculum of elementary schools, especially in the climate of back-to-basics, is not entirely warranted, unless science educators and the public fail to sustain and nurture the positive directions already existent.—HEATHER L. CARTER, Associate Dean for Graduate Studies, College of Education, University of Texas, Austin, Texas 78712.

* Marcuccio, Phyllis. "Metric Education: Trends and Recommendations." *Science and Children*, February 1977, Vol. 14, No. 5.

* Reid, H. Kay and McGlathery, G. "Science and Creative Writing." *Science and Children*, January 1977, Vol. 14, No. 4.

* Raths, James. "Learning Takes Time." Paper presented at the conference, "Back to Basics: Regression or Progression." University of Texas at Austin, November 1976.

Opportunities

Science Education
for American
Indians

Recommendations intended to serve as the basis for discussion of the need to improve science and mathematics education for

American Indians are set forth in the January 1977 issue of *BIA Education Research Bulletin*. Authored by Rayna D. Green and Janet W. Brown of the AAAS

Office of Opportunities in Science, the article, entitled "Recommendations for the Improvement of Science and Mathematics Education for American Indians," addresses needs and makes recommendations focused at precollegiate programs, collegiate professional and pre-professional training, graduate and professional level, and organizations outside educational institutions. A copy of the report can be obtained from the Indian Education Resources Center, Bureau of Indian Affairs, P.O. Box 1788, Albuquerque, New Mexico 87103.

Marine Science
Program for
Handicapped
Students

A summer program in marine science for outstanding handicapped students between their eleventh and twelfth grades of high school will be held 26 June-

29 July at the Marine Science Consortium's Wallops Island station near the Assateague Island National Seashore Park and near Chincoteague, Virginia. The major objectives of the program are to expose gifted precollege handicapped students to field and laboratory experiences and to familiarize them with various aspects of marine science. All types and degrees of severity of handicap will be included in the program.

All students will be housed on campus, with room and board charges of \$67 a week. The station fee is \$25. Costs of travel to and from the program will be provided by the participant. Funds have been made available by the National Science Foundation to assist well-qualified students who might not otherwise be able to afford to participate in the program. After selections for participation are made, the money available for financial assistance will be apportioned among those participants who demonstrate financial need.

To obtain application materials write or phone E. C. Keller, Jr., 237 Brooks Hall, West Virginia University, Morgantown, West Virginia 26506. Tel.: (304) 293-4380. Deadline for receipt of applications is 25 May.

American Association
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